CHALLENGES IN REGULATING THE AIR POLLUTION FROM SHIPS

Axel Luttenberger, Ph.D., Associate Professor
Biserka Rukavina, M.Sc., Assistant
Loris Rak, Junior Assistant
University of Rijeka
Faculty of Maritime Studies Rijeka
Studentska 2, 51000 Rijeka, Croatia
axel@pfri.hr, biserka@pfri.hr, loris.rak@pfri.hr

ABSTRACT

As environmental protection has always been of major concern for the maritime community, the paper is focused on air pollution caused by ships, i.e. the pollutant emissions from ships due to combustion of marine fuels with high sulphur content harming human health, damaging the environment and contributing to acidification. It elaborates both international and national regulations on air pollution from ships, above all Marine Environment Protection Committee MEPC.176 Amendments to the Annex of the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 relating thereto (Revised MARPOL Annex VI). Moreover, the paper analyses regulatory activities of the European Commission, United States Environmental Protecting Agency and International Maritime Organization in an ongoing endeavour to reduce marine emissions. The authors are urging for emission abatement code of behaviour in an effort to find effective worldwide solution in order to develop shipping as a sustainable transport mode that protects health and environment.

Key words: pollution from ships, air pollution, MARPOL, sustainable transport

1. INTRODUCTION

Emissions from the shipping industry contribute considerably to the concentrations and fallout of harmful air pollutants in the world. There are however technical means by which these pollutants could be significantly cut in order to protect health and the environment and to develop shipping as a more sustainable mode of transport.

Shipping is blessed with a green image as a clean way of transporting cargo all over the world. Nevertheless, due to the increasing negative contribution of shipping to air quality and marine litter in coastal areas, the public, politics and pressure groups will aim their arrows more and more on shipping. Therefore it is important for the whole shipping industry to handle pro-active on air-pollution from ships.
2. THE REGULATORY ACTIVITIES OF THE INTERNATIONAL MARITIME ORGANIZATION ON AIR POLLUTION FROM SHIPS

The issue of controlling air pollution from ships, in particular, noxious gases from ships’ exhausts, was discussed in the lead up to the adoption of the 1973 the International Convention for the Prevention of Pollution from Ships (MARPOL Convention). However, it was decided not to include regulations concerning air pollution at the time.

In the mid-1980s, the Marine Environment Protection Committee (MEPC) had been reviewing the quality of fuel oils in relation to discharge requirements in Annex I and the issue of air pollution had been discussed.

Discussions in the MEPC and drafting work by a working group, led to the adoption in 1991, of an International Maritime Organization (IMO) Assembly Resolution A.719 (17) on Prevention of Air Pollution from Ships. The resolution called on the MEPC to prepare a new draft Annex to MARPOL 73/78 on prevention of air pollution.\(^1\)

After years of negotiation, agreement was reached in September 1997. It was agreed to adopt the new Annex through adding a Protocol to the MARPOL 73/78 Convention, which included the new Annex VI, which entered into force on 19 May 2005.

Annex VI contains several important provisions to address air emissions from ships and provides an important tool to help reduce the adverse impacts of international shipping transportation on the global and local environments.

Annex VI sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances.\(^2\)

It includes a global cap of 4.5% on the sulphur content of fuel oil, and contains provisions allowing for special SO\(_x\) Emission Control Areas (ECAs) to be established with more stringent control on sulphur emissions.

In these areas, the sulphur content of fuel used on-board ships must not exceed 1.5%. Alternatively, ships must fit an exhaust gas cleaning system or use other methods to limit their SO\(_2\) emissions. The Baltic Sea Area was the first ECA as from 2006, followed by the North Sea in 2007.

Annex VI also sets limits on the emissions of nitrogen oxides NO\(_x\) for new ship engines, but these standards are so weak that in practice they do not have any appreciable effect.\(^3\)

A mandatory NO\(_x\) Technical Code, which defines how this shall be done, was adopted by the Conference under the cover of Resolution 2.

During negotiations on the revision of Annex VI, a deal was reached by IMO’s member states at an MEPC meeting in October 2008.\(^4\) The MEPC unanimously adopted

---

\(^1\) The IMO Assembly recognised the need to establish a new and additional Annex to MARPOL which would specifically restrict and control the emission of harmful substances from ships into the atmosphere. In order to install the mechanism necessary to achieve this aim, the Assembly requests the MEPC in co-operation with the Maritime Safety Committee: to collect and assess information on machine exhaust and cargo emissions in order to establish a „reference level“ for air pollution levels in ships and on available technology to reduce harmful emissions; develop requirements for reducing air pollution from ship’s machinery and cargo handling operations; and establish fuel oil quality requirements and particularly reduce the sulphur content.

\(^2\) Regulation 14 of the 1997 Protocol.

\(^3\) Regulation 13 of the 1997 Protocol.
amendments to the MARPOL Annex VI regulations to reduce harmful emissions from ships even further. The revised Annex VI will enter into force on 1 July 2010, under tacit acceptance amendment procedure. According to Regulation 3 provisions of this Annex shall not apply to:

a) any emission necessary for the purpose of securing the safety of the ship or saving life at sea; or

b) any emission resulting from damage to a ship or its equipment provided that all reasonable precautions have been taken after the occurrence of the damage or discovery of the emission for the purpose of preventing or minimizing the emission and except if the owner or the master acted either with intent to cause damage, or recklessly and with knowledge that damage would probably result.

The main changes to Annex VI will see a progressive reduction in sulphur oxide emissions from ships, with the global sulphur cap reduced initially to 3.5%, effective from 1 January 2012; then progressively to 0.5% effective from 1 January 2020. The limits applicable in Sulphur Emission Control Areas will be reduced to 1.0%, beginning on 1 July 2010, and being further reduced to 0.1%, effective from 1 January 2015.

Progressive reductions in nitrogen oxide emissions from marine engines were also agreed, with the most stringent controls on so-called „Tier III“ engines, i.e. those installed on ships constructed on or after 1 January 2016, operating in Emission Control Areas.

The revised Annex VI will allow for an Emission Control Area to be designated for SO\textsubscript{x} and particulate matter, or NO\textsubscript{x}, or all three types of emissions from ships, subject to a proposal from a Party or Parties to the Annex, which would be considered for adoption by the Organization, if supported by a demonstrated need to prevent, reduce and control one or all three of those emissions from ships.

The MEPC also adopted amendments to the associated NO\textsubscript{x} Technical Code, to give a revised NO\textsubscript{x} Technical Code 2008. The amended Code includes a new chapter based on the agreed approach for NO regulation of existing (pre-2000) engines established in MARPOL Annex VI, and provisions for direct measurement and monitoring methods, a certification procedure for existing engines, and test cycles to be applied to Tier II and Tier III engines.

The revised measures are expected to have a significant beneficial impact on the atmospheric environment and on human health, particularly for people living in port cities and coastal communities.

3. THE EUROPEAN UNION CLEAN SHIPPING APPROACH

Although it has long been held within the European Union (EU) that shipping is to be dealt by IMO, the Commission has recently been investigating the economic, legal, environmental, and practical implications of co-ordinated EU action for reducing the
emissions of air pollutants from ships. This initiative was partly spurred by the EU directive on national emission ceilings requiring the Commission to present a programme of action for reducing emissions from international maritime traffic.

In November 2002 the European Commission published a strategy to reduce air pollution from sea-going ships and a proposal for reducing the sulphur content in marine fuel oils. The strategy contains a broad series of objectives, proposed actions and recommendations for bringing about such reductions over the next ten years. As part of the strategy the Commission published a proposal for reducing the sulphur content of marine fuels. The proposed directive was first considered by the European Parliament in June 2003, after which the Council of Ministers reached their common position in June 2004. At the time of the second reading in the Parliament, in April 2005, the agreement was reached between the Parliament and the Council.

A Directive 2005/33/EC\(^6\) regulating the sulphur content of marine fuels was adopted in 2005, largely confirming the global Annex VI standards. However, in doing so the EU also introduced additional requirement of its own, including the restrictions on fuel to be used in port that are about to come into force.\(^7\)

Directive 2005/33/EC provides that after 1\(^{st}\) January 2010 all ships berthed or at anchor for longer than two hours in EU ports must use low sulphur fuel of less than 0,1 %. Vessels may be exempted from this requirement if they connect up to shore power supply whilst alongside. There will be a period of after arrival and prior to sailing whilst vessels carry out necessary fuel changeover operations.

Directive 2005/33/EC, like communication on reducing atmospheric emissions from seagoing ships, is a component of a EU strategy to reduce air pollution from ships. At the moment, ships are one of the leading sources of sulphur dioxide emissions in the Union. Research has shown that, by 2010, SO\(_2\) emissions from ships could be equivalent to over 75 % of the emissions from all land-based sources.

It is important to emphasize that the Directive extends the scope of Directive 1999/32/EC\(^8\) to include all liquid fuels derived from petroleum and used by ships operating in Member States’ territorial waters.

It provides, in particular, for:

a) limiting to 1.5 % by mass, from 11 August 2006, the sulphur content of marine fuels used by vessels in the Baltic Sea, and from 11 August 2007 for vessels in the North Sea and the English Channel, in order to reduce acidification and improve air quality;

b) limiting to 1.5 % by mass, from 11 August 2006, the sulphur content of marine fuels used by passenger vessels on regular services to or from any port in the Union in order to improve air quality and create sufficient demand to ensure an EU – wide supply of low-sulphur fuel;

---


\(^7\) This Directive should be seen as the first step in an ongoing process to reduce marine emissions, offering prospects for further emission reductions through lower fuel sulphur limits and abatement technologies, and for economic instruments to be developed as an incentive to achieve significant reductions.

c) limiting to 0,1 % by mass, from 1 January 2010, the sulphur content of marine fuels used by ships on inland waterways and at berth in order to improve air quality around ports and inland waterways;

d) by way of derogation to the abovementioned limits for fuel oil, allowing ships to use an approved emission abatement technology, provided these ships continuously achieve emission reductions which are at least equivalent and that they thoroughly document that any waste streams discharged into enclosed ports and estuaries have no impact on ecosystems;

e) limiting to 1,5 % by mass the sulphur content of marine diesel oils sold in the European Union;

f) limiting to 0,1 % by mass the sulphur content of marine gas oils sold in the European Union;

g) requiring refuelling operations to be recorded in the logbook before ships can be granted access to ports in the Community;

h) ensuring that sulphur content of fuels sold on the territory of the Member States is documented by the supplier, accompanied by a sample.

The Directive also provides for verification of the sulphur content of marine fuels by sampling and analysis. Every year, Member States must send the Commission a report on the sulphur content of the fuels covered by this Directive and used on their territory.

As regards global action under the IMO, the EU and its member states should ensure the adoption and implementation of a revised MARPOL Annex VI in line with the agreement reached by MEPC in April 2008 and make every effort to markedly strengthen the weak emission standards for NO\(_x\) in Annex VI, both for existing and new ships.

To speed up the introduction of low-sulphur fuel and cleaner ships, regulation should be complemented by market-based instruments that apply fair and efficient Community pricing principles to the marine sector.

The EU and its member states should expand the ECAs to include all European sea areas. Currently only the Baltic Sea and the North Sea have ECA status. There is an urgent need for the north-eastern Atlantic, the Mediterranean, and the Black Sea to also become ECAs.

It is important to note that measures such as lowering of the sulphur content of fuels will bring immediate emission reductions. On the other hand, measures that will apply only to new vessels, such as stricter NO\(_x\) emission standards exclusively for new ship engines, will only gradually reduce emissions over a longer time period.

4. THE IMPACT OF THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGULATION ON CLEAN AIR

The United States of America also pursues the activities in reducing air pollution and other environmental problems caused by marine engines. The emissions from marine engines with per-cylinder displacement at or above 30 litres (also called Category 3 marine diesel engines) are considered to be significant contributors to air pollution in U.S. coastal cities and ports. Since these diesel engines are used for propulsion in ocean-going vessels, and as such, are mobile source emitters, they are not easily controlled at the state or local level.

Furthermore, Category 3 marine diesel engines being produced today must meet relatively modest emission requirements and therefore generate significant emissions of NO\(_x\),
fine particulate matter (PM2.5), and sulphur oxides (SOx) that contribute to nonattainment of the National Ambient Air Quality Standards for PM2.5 and ozone. These engines also emit hydrocarbons (HC), carbon monoxide (CO), and hazardous air pollutants or air toxics that are associated with adverse health effects. Emissions from these engines also cause harm to public welfare, and contribute to visibility impairment and other detrimental environmental impacts across the United States.

Since these emissions are expected to increase even more in the future, as U.S. trade with other countries is in increase, the U.S. Environmental Protection Agency (EPA) in its Regulatory Plan and Semi-annual Regulatory Agenda published in fall 2009, stated a need to reduce emissions from Category 3 marine diesel engines to achieve significant public health benefits and help states and localities attain and maintain particulate matters and ozone National Ambient Air Quality Standards established by the Clean Air Act, as amended in 1990.

To achieve this goal, EPA announced the coordinated strategy to ensure that all ships that affect U.S. air quality meet stringent NOx and fuel sulphur requirements.

The EPA strategy will consider long-term nitrogen oxides (NOx) standards for new Category 3 marine diesel engines that would require the use of high efficiency after treatment technology. The standards would be equivalent to the limits for NOx recently adopted by the International Maritime Organization. Furthermore, revision of U.S. diesel fuel program is considered to allow for the manufacture and sale of marine diesel fuel with a sulphur content up to 1,000 ppm for use in Category 3 engines.

As the EPA regulated only the emissions from Category 3 diesel engines on U.S. flagged ships, the proposed strategy announce the adoption the regulations to implement the MARPOL Annex VI, under the authority of the Act to Prevent Pollution from Ships, which will ultimately cause not only U.S. flagged ships, but also foreign flagged ships to comply with applicable Annex VI provisions when they enter U.S. ports or operate in most internal U.S. waters including the Great Lakes.

Finally, the third component of which EPA strategy consist of considers the proposal to amend MARPOL Annex VI to designate Emission Control Area (ECA) of U.S. coastal areas. ECA designation would ensure that ships that affect U.S. air quality meet stringent NOx and fuel sulphur requirements while operating within the designated area, up to 200 nautical miles off U.S. coasts.

5. MARITIME EMMISIONS POLICIES AND INITIATIVES

As pollution from road traffic and land-based stationary sources has been tightly controlled, the contribution of ships and port operations to air pollution has become more important. Although emission controls have reduced pollution from new cars and trucks in a significant level, most ocean-going ships operate without a proper pollution control. Namely, air pollution from road traffic is in the focus of public interest and has declined and at the same time air pollution from ships is not in the focus of the international public awareness, although the air pollution along international shipping lanes can now even be seen from satellites.

The lack of a comprehensive international standard on air pollution from ships has prompted local action of port cities and states where people bear the brunt of ship pollution.
The growing patchwork of local rules and regulations is not a proper manner for regulating environmental protection in shipping industry. Shipping is an international business and therefore international policy on environmental issue is extremely important. International legislation by institutions like IMO and EU are of major importance. Nevertheless, decision-making is slow because many different parties with many different interests are involved.

As expressed in MARPOL Annex VI, the International Maritime Organization develops and promulgates international regulation on air emissions from shipping. Existing and proposed regulatory measures to reduce air emissions from shipping activities tend to focus on the use of heavy fuel oil for ships (“bunkers”), which have formed the basis of marine fuel supplies for many decades. Any changes in legislation on bunker quality will directly impact shipping companies and fuel suppliers, as well as others in the fuel supply chain and in the transport of goods by sea.

In our opinion, air pollution from ships can be reduced either by using cleaner fuels or through use of exhaust gas treatment technology. The cost of all measures will be borne almost entirely by shipowners. Either they will pay a higher price for cleaner fuel, a cost often recoverable through freight and rate adjustment or they will pay for maintenance of fuel purification and emission abatement systems, a cost not likely to be recoverable, and they will assume the liabilities related to disposal. Moreover, supplying cleaner fuels to ships places the burden on refiners who pass the extra costs to shipowners in the price of the fuel.

6. CONCLUSIONS

Current worldwide fleet is set to increase drastically with great opportunities for the world economy. Unfortunately, along with the increase in number of ships, the emissions of the shipping industry will increase. Emissions of sulphur from shipping due to combustion of marine fuels with high sulphur content contribute to air pollution in the form of sulphur dioxide and particulate matter, harming the environment through acidification as well as human health, particularly around coastal areas and ports. More and bigger ships produce more emissions to the environment, influencing marine life and society.

While pollutant emissions from land-based sources are gradually coming down, those from shipping show continuous increase. Because ships and port operations now represent significant sources of air pollution, further regulatory and legislative effort to control their emission is required in order to develop shipping as a sustainable transport mode that protects health and environment.

The IMO has been relatively slow to take advantage of the best available technologies and fuels in the field of combating or reducing air pollution. Namely, the action in ship emission codified improvements already adopted by most of the non-shipping industry on a global level.

The authors are urging to provide incentives from ships to use land-based electricity or clean onboard power while in port. For maritime transport the action should be focused on more stringent rules on clean up marine diesel fuel, setting emission standards for new vessels based on available technologies and setting standards to address climate changes impact. In addition, the authors are advising to combine regulation with market-based instruments and efficient pricing in maritime sector with charges related to the amounts of pollutants emitted.
in combination with voluntary and mandatory agreements on abatement strategies and emission reduction actions of stakeholders.

REFERENCES:


[7] Prevention of Air Pollution from Ships, MARPOL Annex VI – Proposal to initiate a revision process submitted by Finland, Germany, Italy, The Netherlands, Norway, Sweden and the United Kingdom, MEPC/53/4-4.doc


www.ec.europa.eu/environmental/iar/transport/ships.htm
www.helcom.fi)shipping)emissions/en